2025

Enhancing Primary Health Care Operational Data Extraction and Transmission

Expert commentary report

PATH

This report is part of the **PATH Primary Health Care (PHC) Operational Data** suite of materials. Other complementary materials include:

- The Landscape Report identifies key PHC operational data gaps across four countries—Burkina Faso, Ethiopia, Kenya, and Nigeria.

- The Innovation Brief presents 20 innovations that address common data challenges at community and facility levels.

- The Map and Match visualization shows how the identified innovations can address the operational data gaps.

Together, these resources provide a cohesive framework for strengthening PHC dataflows and improving health system performance in low- and middle-income countries.

About

Challenge
Primary health care (PHC) systems in low- and middle-income countries face ongoing challenges in collecting and using operational data needed to manage resources, facilities, and service delivery. Many countries rely on manual, paper-based reporting that creates inefficiencies, fragmentation, poor data quality, and heavy frontline administrative burdens.

Our approach
With support from the Gates Foundation, PATH implemented an activity with two key objectives:

1. Describe the current state of PHC operational data transmission and extraction in four countries, including gaps by health system pillar.

2. Identify and recommend practical and innovative approaches to improve the extraction and transmission of PHC operational data from both the facility and community levels, taking into account gender considerations.

Expert commentary
This report captures key insights from all phases of the project and provides recommendations for strengthening PHC dataflows and improving health system performance in low- and middle-income countries.
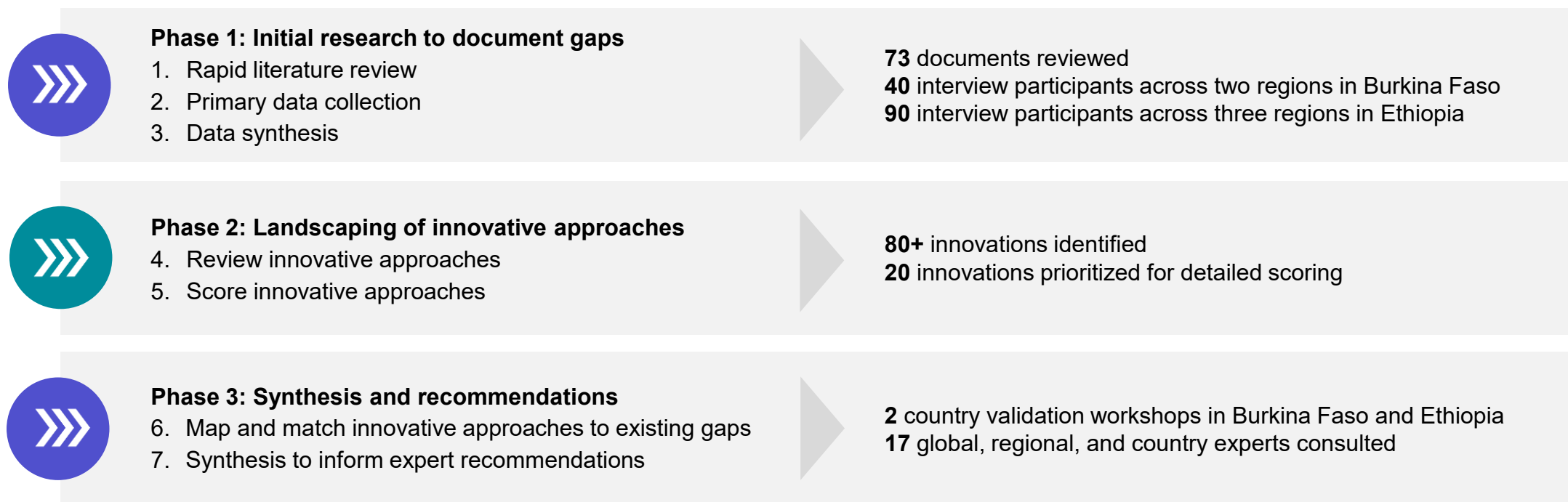
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Methodology

Methodology

PATH implemented a phased approach to document PHC operational data gaps, landscape innovative approaches to address those gaps, and synthesize the results to generate expert recommendations. The mixed-methods approach included document review and thematic analysis, primary data collection in two countries, expert consultations, country validation workshops, and evidence synthesis.

Phase 1: Initial research to document gaps
1. Rapid literature review
2. Primary data collection
3. Data synthesis

73 documents reviewed
40 interview participants across two regions in Burkina Faso
90 interview participants across three regions in Ethiopia

Phase 2: Landscaping of innovative approaches
4. Review innovative approaches
5. Score innovative approaches

80+ innovations identified
20 innovations prioritized for detailed scoring

Phase 3: Synthesis and recommendations
6. Map and match innovative approaches to existing gaps
7. Synthesis to inform expert recommendations

2 country validation workshops in Burkina Faso and Ethiopia
17 global, regional, and country experts consulted

Country (Burkina Faso, Ethiopia, Kenya, Nigeria)   **Global level**

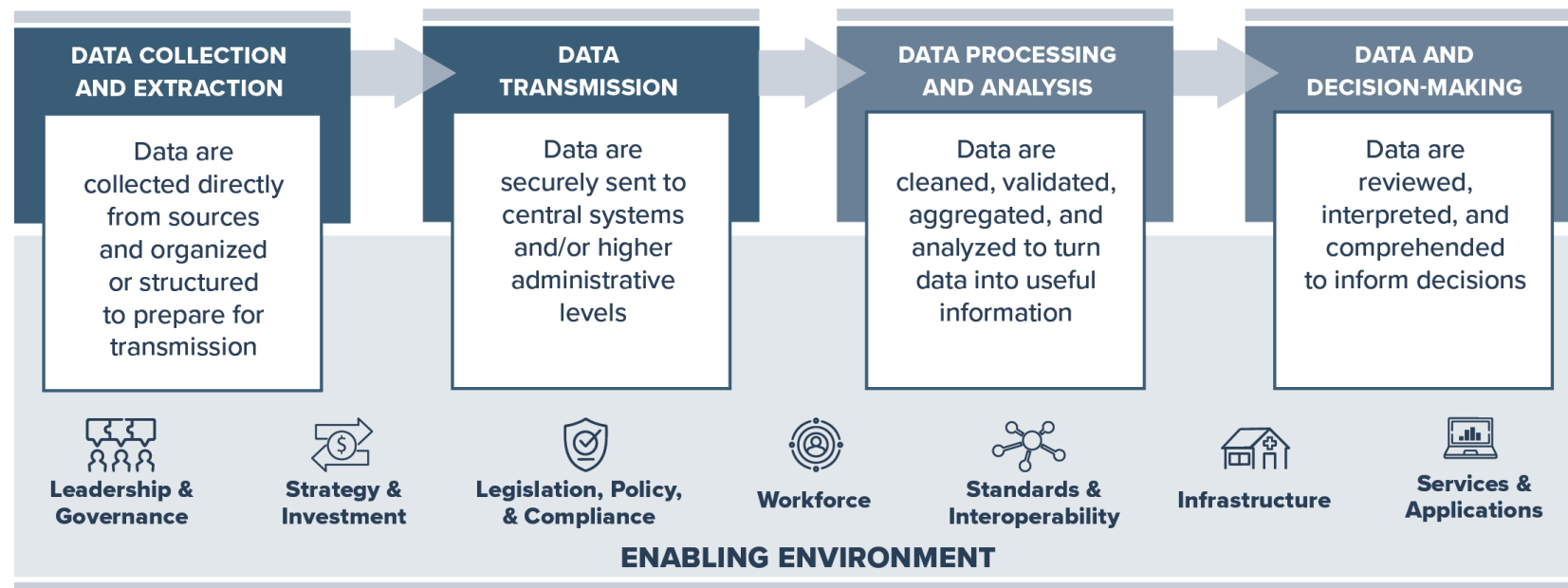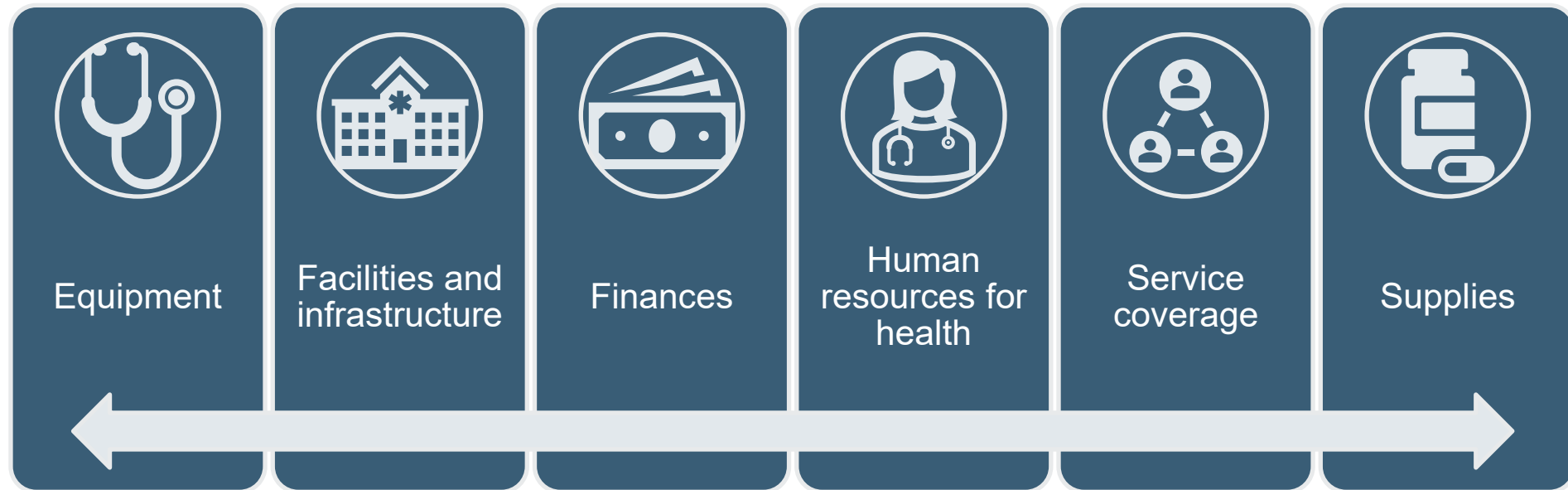PATH

Data value chain

PATH developed an analytical framework to guide the Phase 1 literature review and primary data collection. The framework comprises the **data value chain** that describes the pathway from data collection to data use and the broader **enabling environment** that supports the data value chain.

The primary focus was on the data extraction and data transmission steps in the data value chain, which primarily take place at the community and facility levels.

DATA COLLECTION AND EXTRACTION
Data are collected directly from sources and organized or structured to prepare for transmission

DATA TRANSMISSION
Data are securely sent to central systems and/or higher administrative levels

DATA PROCESSING AND ANALYSIS
Data are cleaned, validated, aggregated, and analyzed to turn data into useful information

DATA AND DECISION-MAKING
Data are reviewed, interpreted, and comprehended to inform decisions

Leadership & Governance

Strategy & Investment

Legislation, Policy, & Compliance

Workforce

Standards & Interoperability

Infrastructure

Services & Applications

ENABLING ENVIRONMENT

Primary Health Care Pillars

PATH reviewed data extraction and data transmission processes for operational data related to six PHC pillars.

Equipment

Facilities and infrastructure

Finances

Human resources for health

Service coverage

Supplies

Landscape of barriers and enablers

Country contexts: PHC system overview

The landscape of PHC barriers and enablers focused on **four African countries** that were purposively selected to represent different regions, language contexts, and stages of digital health maturity; align with the Gates Foundation investment priorities; and leverage PATH staff capacity and strong existing relationships with ministries of health to facilitate implementation.

Burkina Faso	Ethiopia	Kenya	Nigeria
Burkina Faso's health system is decentralized and organized by primary, secondary, and tertiary care. PHC is delivered through health and social promotion centers (*centres de santé et de promotion sociale*) and medical centers (*centres médicaux*). Community-based health workers (*agents de santé à base communautaire*, or ASBCs) are local volunteers who receive a stipend to provide essential services and health education within communities. There are also community-based organizations that provide community services—mainly, community education—and report to health facilities.	Ethiopia's decentralized, three-tier health system consists of primary care (health posts, health centers, and primary hospitals), secondary care (general hospitals), and tertiary care (specialized hospitals). Ethiopia's national Health Extension Program is a community health program implemented by a formalized, paid cadre of health extension workers (HEWs), who provide basic services from health posts and from within the community. They are supported by community volunteers who encourage healthy behaviors and use of PHC services. The country has a community-based health insurance program scaled nationwide to provide coverage for essential services to primarily rural households and informal sector workers.	Kenya has a devolved structure under which the national level sets health policy and provides oversight for 47 County Health Management Teams that lead health planning, management, and resource allocation within each county—including delivery of PHC services. The MOH launched a new community health strategy in 2023 with the goal of strengthening PHC and advancing UHC; the strategy includes expanding coverage of community health promotors, remunerating them for their role, and digitizing community health activities using the eCHIS. The MOH also has been revitalizing PHC by establishing Primary Care Networks to link facilities to provide more integrated, people-centered care.	Nigeria has a federal structure with three levels: federal, state, and LGA. States (although autonomous) align with the national plans and work with the LGAs. The NPHCDA and SPHCDAs coordinate PHC initiatives and service delivery points. CHWs include community health officers, community HEWs, and junior community HEWs who have different levels of training and are employed and paid by the government. In addition, the NPHCDA established the Community Health Influencers, Promoters and Services program in 2018 to coordinate community volunteers. In addition to standard government funding for PHC, Nigeria introduced a performance-based funding mechanism, the Basic Health Care Provision Fund, to support facilities in providing the Basic Minimum Package of Health Services.

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Burkina Faso dataflows

Dataflow for service delivery data by health system level in Burkina Faso
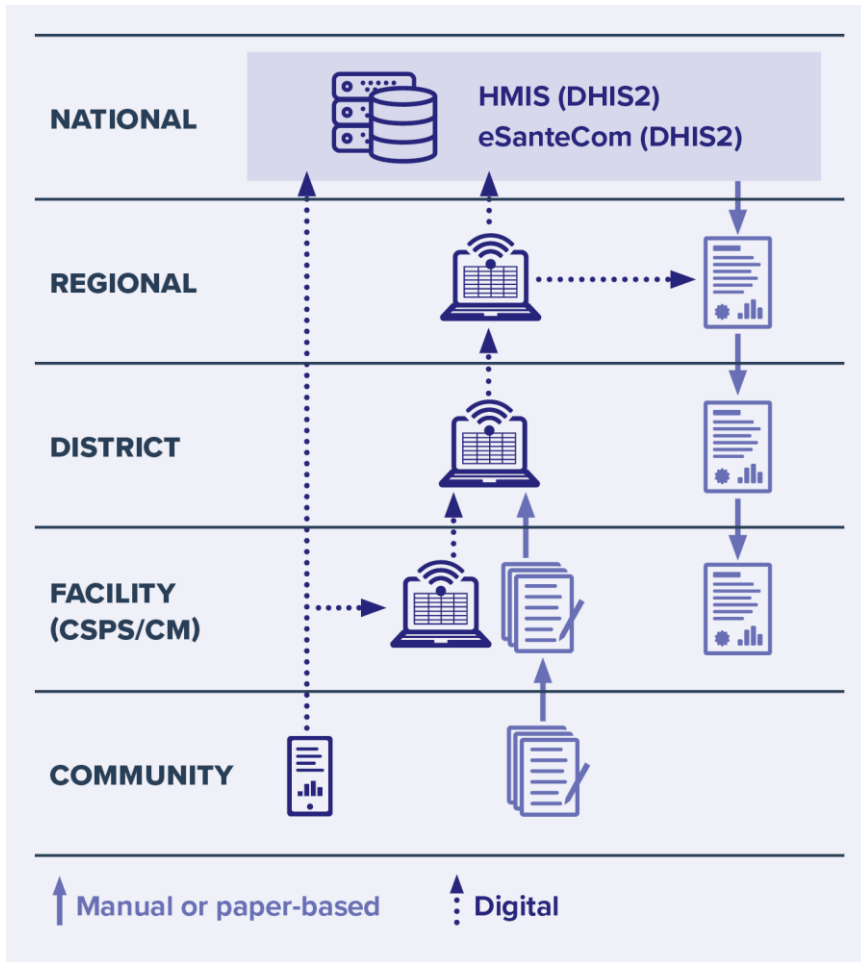
COMMUNITY: ASBCs (*agents de santé à base communautaire)* collect household-level service delivery data in paper-based registers. In some areas where eSanteCom (a CommCare-based community data system) has been introduced, ASBCs use the application in parallel to the paper registers. ASBCs sometimes collect specific data for vertical programs in separate applications, further exacerbating fragmentation.
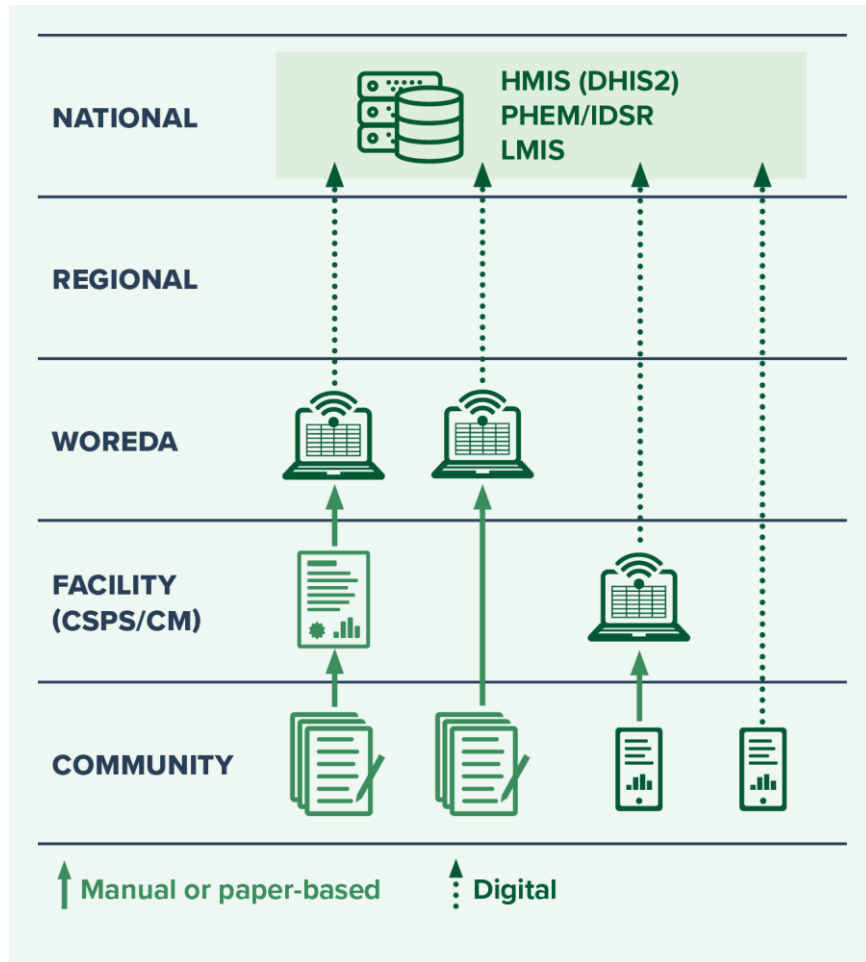
FACILITY: Facility staff use 20+ different paper-based registers and tools to capture data about service delivery, supplies, equipment, finances, human resources, and infrastructure. Facilities compile service delivery data into standardized monthly activity reports.

DISTRICT: District data managers validate and process reports, entering them into the relevant national systems. The district archives paper versions of the monthly activity reports in a dedicated room at the district office and enters data electronically into ENDOS for those facilities that have not entered their own data.

REGIONAL AND NATIONAL: Regional and national managers access and manage routine data from health facilities centrally through ENDOS (DHIS2 based), the national reporting platform. Additional data streams feed into NetSIGL 2.0 (DHIS2 based) for logistics and diseases surveillance (MS Surveillance).

Ethiopia dataflows

Dataflow for service delivery data by health system level in Ethiopia

COMMUNITY: Health extension workers (HEW) generally use paper-based tools (e.g., health cards, service registers) and in some pilot areas they use an electronic community health information system (eCHIS) in parallel to the paper-based tools. They record household-, health post–, and community-level service data and sometimes collect additional data for vertical programs in separate formats. HEWs submit paper-based reports to the health center.

FACILITY: Facilities compile community and facility data using paper registers, client folders, ledgers, and electronic systems (DHIS2, LMIS, HCMIS, MEMIS, iHRIS); perform data quality checks; and report to *woreda* offices. The HMIS focal point enters the community reports into DHIS2. Dashboards and quality improvement teams support evidence-based decision-making.

WOREDA: Woreda offices consolidate community and facility data; analyze them to monitor service coverage, finances, workforce capacity, and infrastructure; and report to regional and national levels. Information Revolution* dashboards are updated every six months to support performance monitoring, planning, and accountability, while demonstration woredas pilot innovations and train staff to ensure timely data use aligned with national reforms.

REGIONAL AND NATIONAL: The Ministry of Health aggregates data from regions and woredas; monitors nationwide service coverage, resource allocation, and health outcomes; and integrates information into policy, planning, and strategic decisions. Standardized reporting frameworks, dashboards, and the Health Sector Transformation Plan guide national data use, ensuring timeliness, quality, and alignment with reforms such as the Information Revolution.

*The Information Revolution, launched in 2016, is a national initiative to digitize health information systems and strengthen data use.

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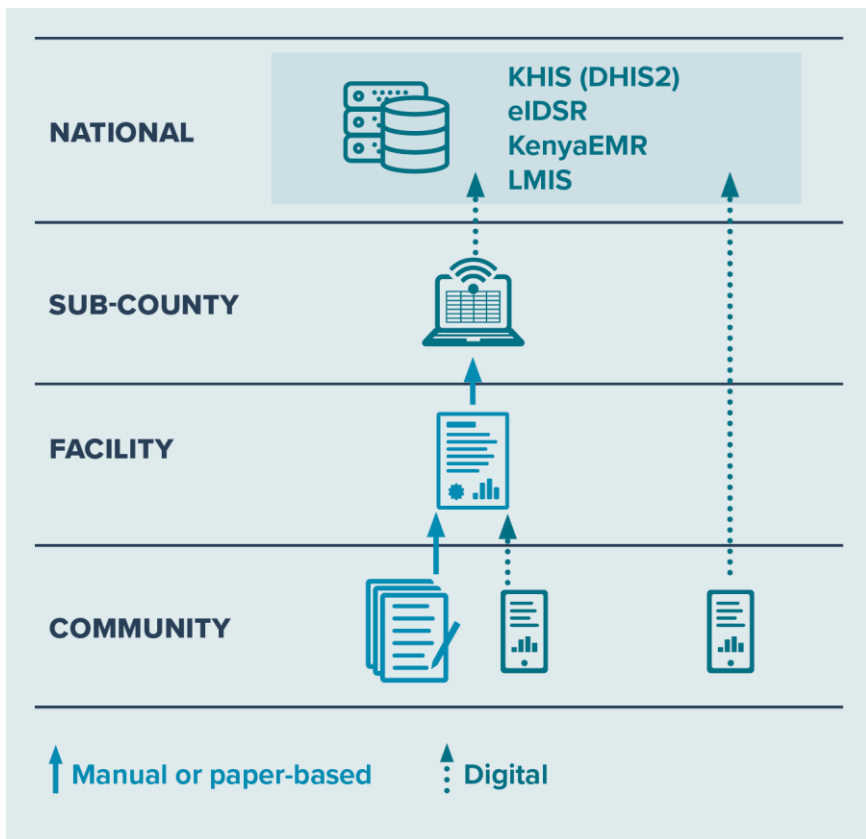
Kenya dataflows

Dataflow for service delivery data by health system level in Kenya

COMMUNITY: Community health promoters (CHPs) capture data using a paper-based household register and logbook which is compiled into a community summary report and submitted to the subcounty monthly. The electronic community health information system (eCHIS) is supporting digital reporting in all 47 counties as of a nationwide CHP training in 2024, with about 42 counties having fully operationalized the system. The eCHIS transmits data directly to the central level, but CHWs are still required to submit the same information through the paper-based monthly reports.

FACILITY: Low-volume facilities tend to be reliant on paper-based forms, whereas some medium- to high-volume facilities are using varied electronic medical records in addition to paper-based tools. Facilities report data on service delivery, financial expenditures, and revenues to the subcounty monthly. Data on human resources, facilities, equipment, and budgets are submitted on an annual basis during the annual work-planning process. Some high-volume facilities report directly into the KHIS (based on DHIS2) not only for service delivery data but also for commodities/supplies and financial data

SUBCOUNTY: County health records and information officers review and input data into the KHIS national reporting platform for their entire subcounty by the 14th of the month for data related to service delivery, commodities/supplies, and financial data. They are responsible for validating facility-level data and flagging data quality issues for feedback.

NATIONAL: The KHIS is the national reporting platform that aggregates facility data, including financial information, HRH data, stock levels, equipment inventory, and service utilization. Other national health information systems used at scale include an electronic medical record system, laboratory information system, logistics management information system, Kenya Master Health Facility List, and integrated human resources information system.

Nigeria dataflows
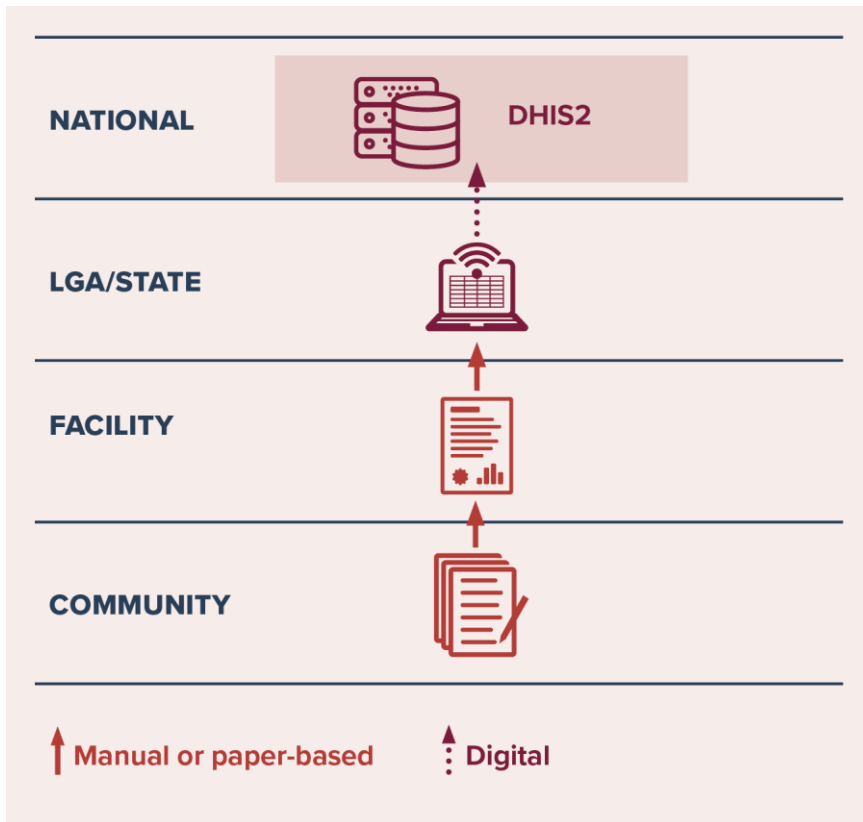
Dataflow for service delivery data by health system level in Nigeria

COMMUNITY: Health data from community-level activities flow into the PHC facility, which serves as the main source point for PHC data. Community-level PHC activities vary by LGA/state but are usually focused on community engagement, education, and awareness and are supported by resources from health care facilities within the community's geographic area. CHWs primarily use paper-based tools to collect and record data. Data are shared with the facility and captured in facility registers.

FACILITY: The facility aggregates data for community-level activities. Data on service delivery, finances, and HRH attendance are captured daily through various registers. Aggregate details related to service delivery and stock data are manually extracted to complete monthly reports that are submitted to the ward/LGA level. Other types of data (e.g., related to HRH, equipment, or facility infrastructure) are reported on demand when requested by higher administrative levels.

LGA/STATE: Data review meetings are routinely held to validate the monthly summary reports across facilities in the LGA. When completed, the LGA M&E officers aggregate data for their LGAs and further validate them with the state M&E officer, who then inputs data in the NHMIS (DHIS2 based). State-level operational decisions are made based on data available through the NHMIS.

NATIONAL: At the national level, data are accessed through the NHMIS. Other nationally scaled systems that support PHC include the Nigeria Health Workforce Registry, the Health Facility Registry, and the National Data Repository. There is a digital PHC dashboard managed by the National PHC Development Agency to highlight service availability, readiness, and health insurance status.

Abbreviations: CHW, community health worker; HRH, human resources for health; LGA, local government area; M&E, monitoring and evaluation; NHMIS, Nigeria health management information system; PHC, primary health care.

Cross-country insights on dataflows

- **Common dataflows observed:** CHWs and facility staff collect and aggregate PHC operational data, which are compiled into standardized MOH reports and submitted to districts.

- **Multiple, overlapping tools:** Although reporting forms are generally standardized, there are many, and they sometimes capture overlapping information. For example, basic patient or facility information must be entered multiple times across different tools.

- **Reliance on paper:** Most facilities—especially in rural and low-volume settings—still rely on paper-based registers and monthly paper report submissions, sometimes supplemented by hybrid paper-digital systems.

- **Data responsibilities:** Data tasks are typically done by clinical staff / nurses in rural or low-volume facilities, whereas dedicated health records and information officers / data clerks are more common in urban and high-volume sites.

- **Reporting frequency:** Service delivery data are reported monthly; HR, equipment, and facilities/ infrastructure data are reported less frequently or ad hoc.

- **Community-level reporting:** Countries are increasingly digitizing community-level reporting (eSanteCom in Burkina Faso; eCHIS in Ethiopia and Kenya); though in most cases the digital systems are used in parallel to required paper-based reporting.

- **Data quality gaps:** Manual reporting processes at community and facility levels continue to drive data quality gaps across all four countries.

- **Gender disparities:** There are disparities in data responsibilities between women and men, partly resulting from gender imbalances across health-sector positions with a higher concentration of women in frontline roles

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Cross-country enablers and barriers to PHC data flows

CATEGORY	✓ ENABLERS	✗ BARRIER
Tools Includes the design, usability, and function of digital and non-digital tools used to extract and transmit PHC operational data.	National HIS is based on DHIS2 and provides a common platform for reporting Routine sex disaggregation of data, particularly for service delivery Use of digital tools that can improve ease, timeliness, and security of data reporting and offer real-time decision support	Fragmented and sometimes overlapping reporting tools, causing duplication, inconsistencies, and confusion

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Cross-country enablers and barriers to PHC data flows (2)

CATEGORY	✓ ENABLERS	✗ BARRIER
Infrastructure Includes physical infrastructure (e.g., electricity, internet connectivity, solar power), facility infrastructure (e.g., adequate space, quality of space), and essential supplies and equipment (e.g., digital tools, hardware, paper forms).	Progress on national blueprints/standards for interoperability	Weak/unstable internet and electricity, particularly in rural areas
		Limited availability of devices (computers, tablets)
		Lack of maintenance for devices
		Inadequate space for data work
		Limited, poor-quality storage areas for paper-based forms
		Shortages of paper-based tools
		Inadequate transport for submitting paper reporting forms

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Cross-country enablers and barriers to PHC data flows (3)

CATEGORY	✓ ENABLERS	✗ BARRIER
Processes Includes workflow practices, SOPs, supervision processes, and data quality and validation checks related to PHC data extraction and transmission.	• Structured reporting pathways from subnational to national levels • Processes in place for data validation and supportive supervision	• Time-consuming manual processes for data extraction, which can lead to delayed reporting • Manual processes that can result in errors • Inconsistent SOPs for data extraction and transmission; limited awareness of SOPs • Weakly implemented feedback and data validation mechanisms

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Cross-country enablers and barriers to PHC data flows (4)

CATEGORY	ENABLERS	BARRIER
People Includes the responsibilities, bandwidth, competing priorities, motivation, training, and capacity of health system actors involved in PHC operational data extraction, transmission, and use.	• Dedicated data staff (HRIOs, data clerks) who support processes in higher-volume facilities • Training to support workforce capacity-strengthening	• Health care workers who are overburdened with clinical and reporting tasks; competing priorities (outbreaks, campaigns), which can delay reporting • Lack of data support staff in lower-volume, rural facilities • Training that is inconsistent, donor dependent, or not reaching lower-level facilities • Concentration of women in lower level/frontline roles, meaning they often have unequal access to training and more data responsibilities • Limited use of data at community and facility levels; low perceived value of data

Cross-country enablers and barriers to PHC data flows (5)

CATEGORY	✓ ENABLERS	✗ BARRIER
Governance & Policy Includes national and/or subnational regulatory requirements, accountability structures, budget allocation procedures, and coordination mechanisms governing PHC operational data.	• Involvement of technical committees that strengthen coordination in support of PHC systems and processes • Robust national policies related to PHC and HISs • Recognition of gender in policies	• Gaps in the implementation and enforcement of policies, especially at subnational levels • Acknowledged gender mainstreaming that is nevertheless weakly implemented • Lack of formal standards for data privacy and confidentiality • Limited coordination mechanisms across vertical disease programs • Limited multisectoral collaboration between ministries (health, finance, ICT) and local governments

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Insights on the landscape of barriers and enablers

Barriers to data extraction and transmission are interrelated, and similar challenges were identified across health system levels and across PHC pillars.

Expert consultations confirmed that the barriers aligned with experts' experiences supporting PHC dataflows across countries. They mentioned similar challenges related to tools, infrastructure, processes, people, and governance and policy.

While the project focus is at the community and facility levels, experts highlighted the importance of political commitment over time and the need to make a longer-term strategy and push forward on it.
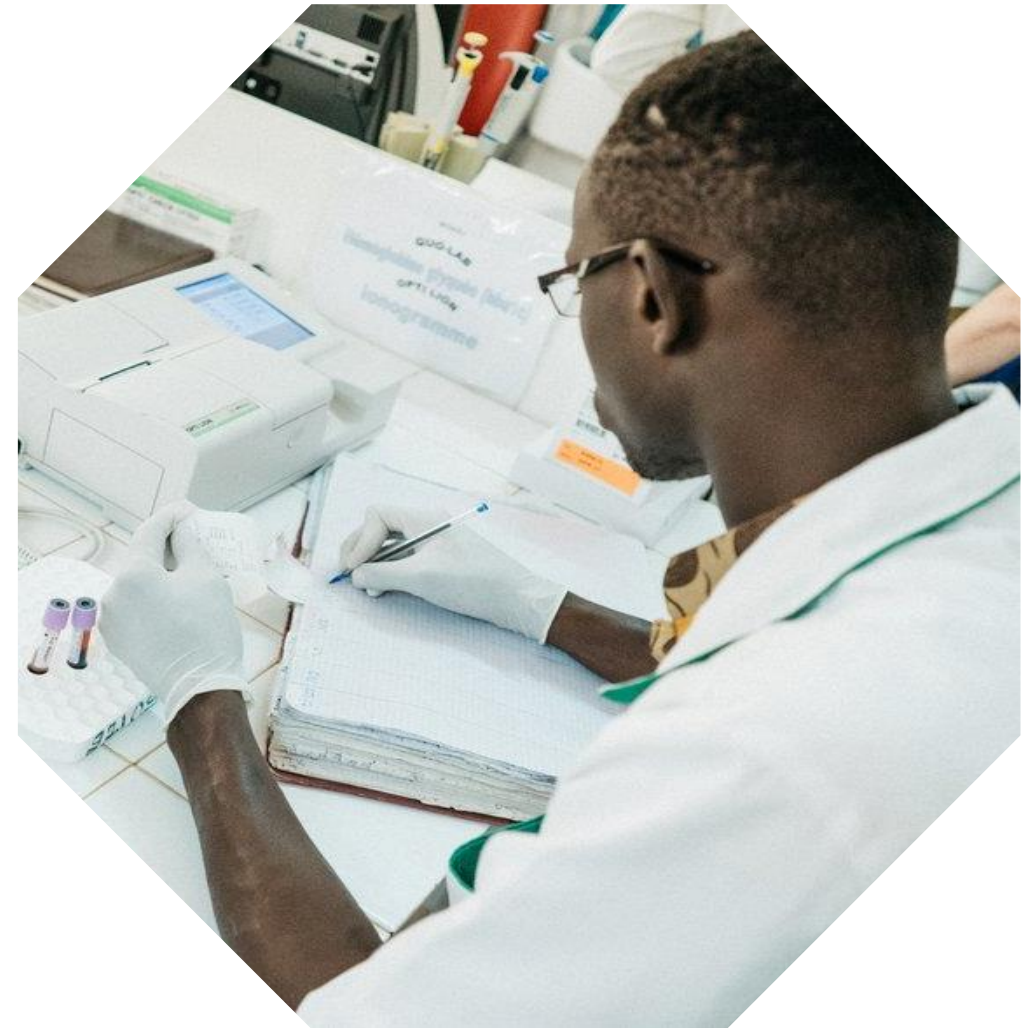
Experts suggested additional barriers, including:

- The financial and environmental implications of storing increasing amounts of data digitally.

- Collecting more data than we are using

- Lack of maintenance culture for dashboards

- Not capitalizing on teaching institutions for pre-service training on data collection and use (missed opportunity)

- Power dynamics and interpersonal collaboration

- Performance-based incentives that result in "data cooking" and poor data quality

- Lack of unique identifiers and inability to track individual-level data
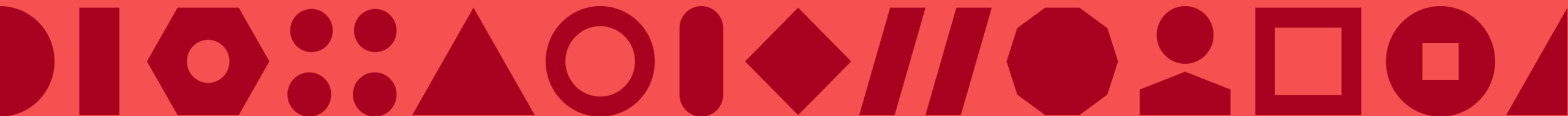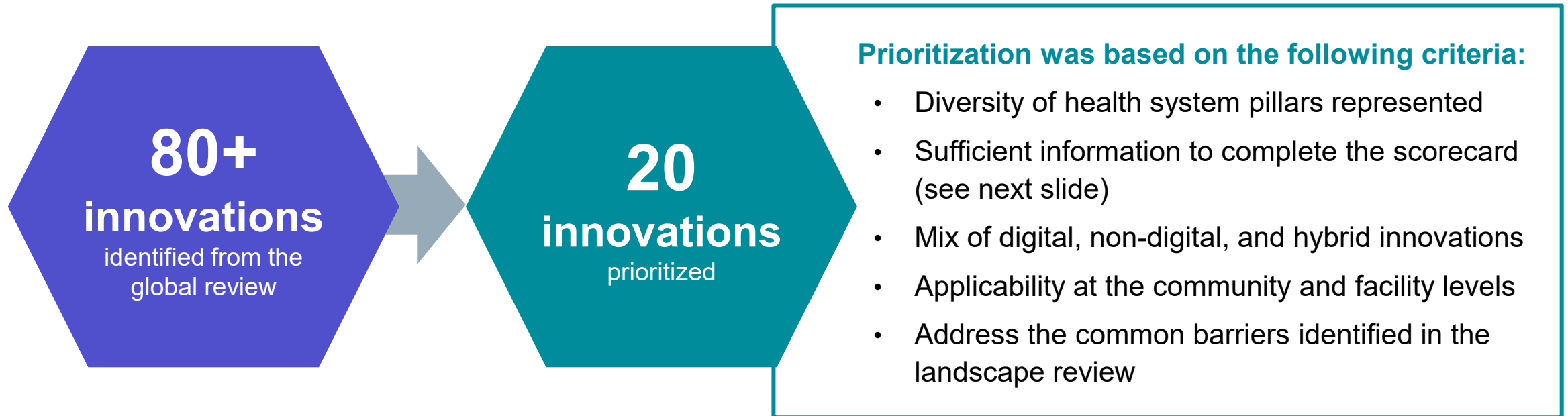
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Innovations

Identifying innovations

PATH conducted a global landscape review to identify practical and innovative solutions—both technological and non-technological—that can strengthen PHC data systems without requiring full system overhauls. The focus was on innovations to improve data extraction and data transmission, which primarily take place at the community and facility levels. Drawing insights from health and other sectors, we highlighted adaptable approaches suited for resource-limited settings.

Prioritization of innovations

80+ innovations identified from the global review

20 innovations prioritized

Prioritization was based on the following criteria:

- Diversity of health system pillars represented
- Sufficient information to complete the scorecard (see next slide)
- Mix of digital, non-digital, and hybrid innovations
- Applicability at the community and facility levels
- Address the common barriers identified in the landscape review

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Innovation scorecard

PATH developed a structured scorecard to compare innovations in a standardized way. The scorecard describes the innovation, captures information (metadata) about its applicability, and assesses how it performs across key domains.

Innovation
Intervention name
Intervention description
Tools identified
Intervention link(s)

Metadata
Innovation type (digital, non-digital, hybrid)
PHC pillar(s)
Gap(s) addressed
WHO Digital-Health-Intervention (DHI) tag
Health system level
Site maturity

Domain	Description
Scalability	The intervention's capacity to scale and endure—it probes the conditions that foster, or obstruct, wide rollout and long-term affordability.
Gender and equity responsiveness	The extent to which the intervention reduces barriers for female health workers, low-literacy users, or marginalized communities.
Risk and compliance	How well the health-information system complies with a country's policy framework and respects rules on sensitive data.
Interoperability	This domain tests two things: How smoothly the tool exchanges data with existing platforms (interoperability) and whether it simplifies, rather than clutters, everyday work (complementarity).
Operational fit and change-management fit	How readily an intervention integrates into existing workflows and the level of ongoing support it demands.
Cost – startup and sustainability	The extent to which an intervention's financial profile—both the initial outlay and the ongoing expense—fits the means of the health system that aims to adopt it.
Impact potential and data-quality safeguards	Measures both the operational gains an intervention delivers and the rigor with which it protects data integrity.
Maturity / readiness	How far an intervention—digital or non-digital—has progressed from concept to dependable routine use.

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Innovation scorecard (2)

For each domain there is a scoring rubric with clear definitions for rating dimensions as high, moderate, or low. The users assigns a numeric score (1 to 5) and describes the motivation or rationale for the score. Each domain may include multiple dimensions that are scored. For example, the cost domain includes rubric dimensions for startup investment and sustainability.

Cost – Startup and Sustainability

This domain considers whether an intervention's financial profile — both the initial outlay and the ongoing expense — fits the means of the health system that must adopt it.

Dimension	5 – High	3 – Moderate	1 – Low	Score	Motivation
Startup Investment	One-time costs align with routine capital budgets; no exceptional financing required	Start-up outlay is higher than usual but feasible with minor reallocation or one-off donor support.	Up-front costs exceed normal capital budgets and depend on substantial external funding.		
Sustainability	Recurring costs are modest and at least one firm cost-control lever (open source, local production, phased purchasing, proven savings) is built in.	Costs seem tolerable but exceed current allocations; a lever is proposed yet untested.	No credible mechanism exists to underwrite running costs after project funding; affordability rests on future, uncertain subsidies.		

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Innovations mapped to the data value chain

The 20 prioritized innovations were mapped to the data value chain.

- **Data extraction:** Innovations that support frontline workers to collect data directly from sources and organize and/or structure the data to prepare for transmission.

- **Data transmission:** Innovations that support securely sending data to central systems for analysis.

- **Enablers:** Innovations that are not specific to data extraction or transmission but provide cross-cutting support across the data value chain.

INNOVATIONS

EXTRATION	
	Collect only essential data elements for registers and reporting
	Color-coded kanban stock cards
	Investing in data clerks
	Marble Jar for workload management
	Peer review / pair checking of data entry
	Pictorial paper forms
	Supervision, Performance Assessment and Recognition Strategy (SPARS) program

EXTRATION + TRANSMISSION	
	Biometric attendance systems for workforce management
	Solar-powered cold chain with connected sensors
	Smart Paper Technology

TRANSMISSION	
	Photo to Digital - ODK Scan
	Physical courier with scheduled data pickup
	Remote photo-based reporting and mapping
	Signalytic
	SnapForm AI-OCR of paper forms and registers
	WhatsApp for coordination
	Wifi Direct

ENABLERS	
	Clear role definition and accountability
	Solarization of PHC facilities for reliable power
	WhatsApp groups for peer learning and mentorship

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Insights on the innovations

- **The innovation scorecard can be considered a global good** that can support consistent assessment of future innovations. The scorecard is designed to filter or weight scores by domain to help tailor results to local priorities. For instance, a user may filter only non-digital innovations for a low maturity setting or may weight the domain scores to prioritize impact potential. Several stakeholder emphasized the outsized importance of effectiveness and impact potential compared to other domains.

- **The scorecard is designed to apply across different types of innovations.** Innovations may be digital, non-digital, or hybrid. Some innovations are specific tools (e.g., SnapForm) whereas other innovations are strategies (e.g., invest in data clerks).

- **Multiple innovations can have similar objectives**; for instance, both SnapForm and Open Data Kit (ODK) support data transmission by taking a photo of a paper form and digitizing it. We considered grouping innovations with similar aims but ultimately decided against it because completing the scorecard required assessing each tool individually, and their scores differed across domains. The innovation scorecard can be used to compare similar solutions across key domains.

- While focusing on innovations to improve data extraction and transmission allowed for a realistic and manageable scope, **there is inherent overlap across steps in the data value chain**. For example, innovations that primarily aim to improve data use at frontline levels can motivate health care workers to strengthen data extraction and transmission practices.

- **Future efforts should engage innovation owners or implementers to validate scoring** – similar to the participatory approach used in the Digital Square Global Goods Guidebook.

- While the global landscape review of innovations drew on diverse literature, reports, websites, and expert consultations, **a broader crowdsourcing effort could surface additional promising innovations**.

- One expert noted that **the health sector can learn from the financial industry**, which successfully built interoperable data exchanges (e.g., a visa card can be ready by any ATM) and strong consumer trust in data protection. Data security did not emerge as a major barrier in the landscape assessment, but it is a critical consideration as more individual-level health data are digitized.

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Examples of emerging innovations

Many emerging innovations—including several AI-drive solutions—were not included in this report, even though some were identified through the global review and expert consultations. Some were excluded because they do not specifically address data extraction or transmission, while other lacked sufficient evidence or documentation to complete the scorecard. Future pilots could help generate the evidence needed for their inclusion.

AI-assisted decision support

- **Example:** Early-warning models for outbreaks or stockouts.
- **Potential:** Enables anticipatory action.

Geospatial route optimization

- **Example:** Lalana "Waze for CHWs" uses OpenStreetMap and remote sensing to map footpaths, estimate walking times, and plan outreach.
- **Potential:** Improves travel efficiency and planning for CHWs.

AI for data-driven health system optimization

- **Example:** Causal Foundry utilizes large RSSB claims data sets to design capitation formulas and enable real-time quality monitoring.
- **Potential:** Supports evidence-based financial planning and continuous quality improvement.

AI-driven tools for audio to text

- **Example:** Sahara provides speech recognition and text to speech models for African accents.
- **Potential:** Supports CHWs with limited literacy.

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Map and match

Map and match approach

The "map and match" visualization is a user-friendly matrix that crosswalks barriers identified through the landscape review with innovations that can address them.

- Rows list the barriers.

- Columns list the innovations.

- Each cell shows whether and how an innovation responds to a particular challenge.

The tool enables the user to identify innovations that can address a barrier by reducing it or bypass the barrier by avoiding it altogether.

Map and Match: Primary Health Care Operational Data Barriers and Innovations

Insights on the map and match

The approach of identifying barriers and mapping innovations to those barriers proved effective in ensuring that selected innovations addressed locally defined needs.

There are many other health systems strengthening interventions that while not particularly innovative, may be effective at addressing the identified barriers.

- Stakeholders in Ethiopia suggested: technical and logistical support, maintain digital infrastructure, mentorship and supervision, timely feedback, power backup, and capacity building trainings.
- Stakeholders in Burkina Faso suggested: technical support, equipment and infrastructure planning, promotion of the gender approach, and backup power solution.

The approach highlighted which barriers did not have corresponding innovations, including:

- Inadequate space for data work
- Shortage of paper-based tools
- Lack of secure storage for records and devices

Some barriers are more straightforward to address than others and do not require new, innovative approaches. For instance:

- A shortage of paper-based tools can be addressed by printing additional tools or allocating more resources to printing.
- Limited availability of devices can be addressed by procuring additional devices or creating/updating policies for bring your own device (BYOD).
- Inconsistent use of standard operating procedures (SOPs) can be addressed by simplifying or redesigning SOPs and implementing a change management plan to increase awareness and use (which could include printing SOP posters or making SOPs available online or in digital format accessible on phone/tablet).

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Recommendations

Insights and recommendations

Countries are highly focused on advancing nationwide digitalization and continuing to scale existing systems. Transitioning to digital systems directly addresses PHC operational data gaps such as time-consuming manual processes and health worker burden, while also bypassing constraints like shortages of paper tools or limited transport for submitting paper-based reports.

Countries value innovations to support or accelerate nationwide digitalization. Innovations that strengthen infrastructure—including solar-powered systems for reliable power and connectivity—are particularly relevant to support the use of digital tools for data extraction and transmission.

Countries should consider whether innovations can provide interim support for PHC dataflows while countries are moving towards digitalization. National digitalization roadmaps could be adapted to include plans for supporting PHC dataflows during the transition.

Countries should review foundational aspects of their PHC data value chain—including data responsibilities, reporting requirements, supervision, and capacity—and determine where innovations could reinforce and strengthen these core components. For instance, clear role definition and collecting only essential data are good practices that can apply across settings, regardless of maturity.

Introducing new innovations should be balanced with scaling proven solutions and strengthening the enabling environment. There is a history of innovations introduced by partners or donors that are not scaled and eventually phased out, which has resulted in skepticism of innovations. Strong governance, infrastructure, and standards are critical components of the enabling environment needed to support scalable, sustainable innovations.

Continued efforts are needed to build the evidence base for innovations as they are implemented, as data on effectiveness—particularly for newer solutions —is limited.

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How innovations support PHC dataflows

Accelerate nationwide digitalization of PHC operational data

Countries should introduce innovations to support or accelerate scaleup of digitalization in line with national priorities and implementation roadmaps.

Support PHC dataflows during the transition to digitalization

Countries should consider whether innovations can provide interim support for PHC dataflows while countries are moving towards digitalization.

Strengthen foundational aspects of PHC data value chain

Countries should review foundational aspects of their PHC data value chain—including data responsibilities, reporting requirements, supervision, and capacity—and determine where innovations could reinforce and strengthen these core components.

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Recommended innovations to accelerate nationwide digitalization

As countries focus on scaling existing digital systems, weak infrastructure at both community and facility levels is a major barrier to frontline use of digital tools. In low maturity sites, innovations can improve consistent electricity and internet connectivity. In high maturity sites with reliable infrastructure and strong governance and leadership, more advanced digital innovations can be introduced.

Recommended innovations for **low maturity** sites:

- **Solarization of PHC facilities for reliable power** which includes battery storage to ensure routers, computers, and information systems remain powered during outages.

- **Solar-powered systems for internet connectivity** such as Signalytic which can operate with intermittent network connectivity by generating its own Wi-Fi network using distributed ledger technology.

Recommended innovations for **high maturity** sites:

- **Solar-powered Internet of Thing (IoT) cold chain sensors**, such as those integrated with Nexleaf ColdTrace, continuously monitor temperatures in vaccine refrigerators and include battery storage to survive intermittent connectivity and power outages.

- **Fingerprint or biometric scan** to capture "who's here" for workforce management to automate tracking, reduce manual processes and errors, and improve data validity.

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Recommended innovations to support during the transition to digitalization

Several innovations can provide interim support for PHC dataflows while countries are moving towards digitalization in the longer-term. Interim solutions should be selected based on the most significant local barriers and site maturity.

BARRIER	SITE MATURITY	RECOMMENDED INNOVATION(S)
Weak/unstable internet	High	Introduce solar-powered systems for reliable Wi-Fi (Signalytic)
	Low	Use Bluetooth-based data transfer (Wifi Direct) or WhatsApp as temporary data sharing workarounds*
Overburdened health care workers who rely on manual processes that are time-consuming and error prone	High	Invest in data clerks to support data reporting tasks, particularly for time-consuming, manual processes
	High	Digitize paper-based data through a photo-to-digital solution (ODK Scan, SnapForm)*
	Low	Invest in data clerks to support data reporting tasks, particularly for time-consuming, manual processes
	Low	Digitize paper-based data through a photo-to-digital solution (ODK Scan, SnapForm)*
	Low	Introduce the marble jar to visually monitor workloads and redistribute tasks as needed
	Low	Use redesigned paper forms that are later scanned and digitized (Smart Paper Technology)
	Low	Implement peer review of data for human validation in the absence of a digital tool with built-in validation
Low literacy; language barriers	Low	Develop and introduce pictorial paper forms using clear visuals to support staff to reliably perform tasks
Stockouts	Low	Use a simple, non-digital system (color-coded kanban stock cards) to visually indicate stock levels / reorder points, replacing complex tally sheets and simplifying inventory management

Though these innovations can work in low maturity sites, they require access to a device (phone, tablet).

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Recommended innovations to strengthen data foundations

Several of the innovations are strategies or good practices that can strengthen foundational aspects of the PHC data value chain. They are generally applicable across PHC pillars, most are relevant for high or low maturity sites, and they are complimentary and could be jointly implemented.

Recommended innovations:

- **Clear role definition and accountability** to formalize roles and responsibilities for data management, strengthen accountability, and improve team coordination for data tasks.

- **Collect only essential data elements for registers and reporting** can be applied across paper-based or digital tools to streamline data collection using a reduced list of essential indicators, reducing the burden of data collection, minimizing opportunities for errors, eliminating duplicate entry, and focusing reporting on priority information for decision-making.

- **Strengthen supportive supervision for data management,** such as through the Supervision, Performance Assessment and Recognition Strategy (SPARS) program in Uganda. While this innovation has been implemented specifically for stock management, the approach could be adapted for other PHC pillars.

- **WhatsApp groups for peer learning and mentorship** to connect facility or community staff and enable peer-to-peer knowledge sharing, real-time troubleshooting of data issues, and collaborative problem-solving on a familiar and user-friendly platform.

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Selecting an innovation

✓ Assess the local context to identify the most significant barriers to PHC operational dataflows.

✓ Find each barrier in the map and match table to see which innovations address or reduce the barrier.

✓ If there are multiple innovation options, use the innovation brief to compare innovations. Consider:

- Whether the innovation is digital, non-digital, or hybrid—and if governance and infrastructure are in place to support digital or hybrid solutions

- If the innovation is tied to a specific PHC pillar or is pillar-agnostic

- The site maturity required to support the innovation

- Strengths and limitations of the innovation based on scores across key domains

✓ Consider whether the innovation:

1) supports scale-up of nationwide digitalization,

2) provides interim support for PHC dataflows during the transition to digitalization, or

3) strengthens foundational aspects of the PHC data value chain.

✓ Develop an implementation roadmap as a practical, actionable guide for introducing and scaling the innovation.

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Recommendations to address gender considerations

While none of the 20 prioritized innovations explicitly target gender-related barriers, the way the innovations are implemented can influence gender considerations related to data responsibilities and dataflows. Those overseeing the implementation of innovations should:

- Ensure that women and men in data management functions have **equal access** to smart phones, internet connection, and data plans. Where this is not the case, prioritize equitable investments in these inputs.

- Engage women health workers at the facility level, especially those with limited experience using digital tools, in **digital tools training** and use. Consider the gender-related barriers that many women face in accessing training opportunities (i.e., limited time available to take advantage of training opportunities due to disproportionate responsibilities).

- Assess the **use of sex-disaggregated data** for decision-making and consider developing case studies to document whether and how the increased availability of sex-disaggregated data has influenced the targeting of health service delivery and rational use of resources.

- Use quantitative and qualitative approaches to **monitor the implementation** of innovations. Qualitative methods (e.g., interviews or focus groups) can capture nuanced insights into how women and men health workers are differently impacted by the innovations, including impacts on time use, access to training opportunities, skills and capacity, and workplace recognition.

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Looking ahead: Implementation roadmaps

For countries considering implementation of an innovation, we recommend developing a high-level implementation roadmap as a practical, actionable guide that can be used by country stakeholders and development partners to inform implementation planning.

Outline for implementation roadmap

- Innovation overview

- Specific PHC operational data gaps to address

- Implementation requirements and prerequisites

- Estimated timeline and costs

- Measurement approach for evaluating impact

- Potential risks and mitigation strategies

Resources to consult

- Digital implementation investment guide (DIIG): integrating digital interventions into health programmes (2020), a reference document published by the World Health Organization as a practical guide for countries.

- DIIG: quick deployment guide (2022), a shortened 'how to' manual with fillable worksheets that can be used during planning workshops.

- Stepwise Toolkit for Planning & Budgeting Interoperability of Digital health Solutions (2022), published by the Digital Health Centre of Excellence (DICE).

- The Data Use Partnership Tanzania Digital health Investment Roadmap 2017-2023, an example of a comprehensive implementation roadmap with specific activities, costs, and timelines.

- Digital Health Impact Framework User Manual, published by the Asian Development Bank (ADB) as a methodology for assessing digital health investments.

- Total Cost of Ownership Tool, an interactive budgeting tool published by Digital Square to support development of realistic budgets for digital health projects.

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